World Water

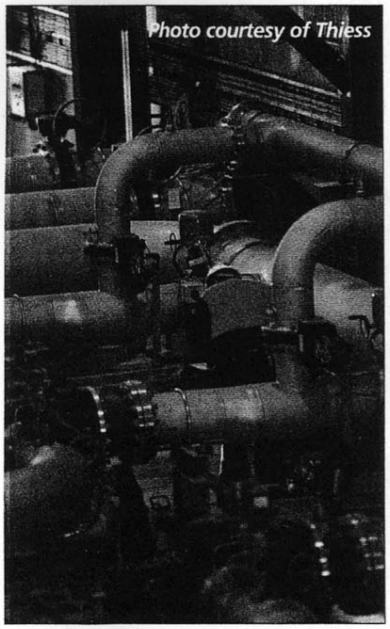
Bundamba facility recycles wastewater for indirect potable reuse

Australia's first large-scale indirect potable reuse scheme uses the latest membrane and advanced oxidation technologies -- ultrafiltration, reverse osmosis, advanced oxidation using ultraviolet irradiation, and hydrogen peroxide – as part of the US$ 1.8-billion Western Corridor Recycled Water Project that will secure water supply for the rapidly growing yet drought-stricken southeast Queensland. Principal Structural Engineer ***Michael Salu*** *of the project's engineering services provider Parsons Brinckerhoff reports on the award-winning facility.*

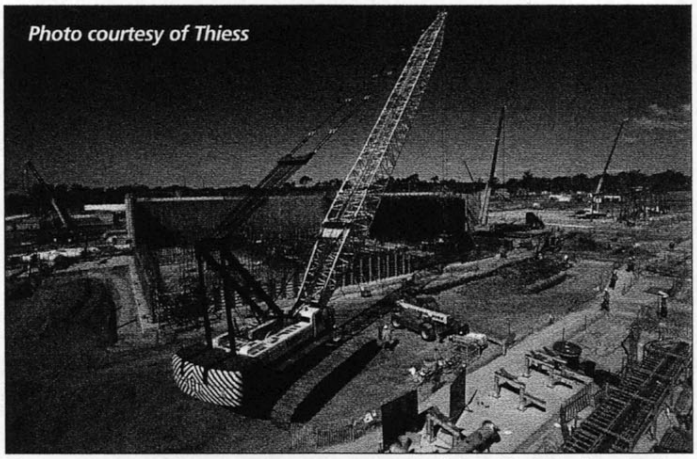
Commissioned in June 2008, Australia's largest water-recycling project can produce up to 66 million liters/day (ML/d) using a combination of existing water treatment technologies not previously attempted to treat domestic and industrial wastewater for potable reuse.

Water from the plant will initially be used to supply power stations with water to save the town's water supply for domestic use. Later, water will be supplied for industrial use and eventually pumped directly into a water supply dam. From there, it will be processed through the normal water supply treatment system. This process is termed indirect potable reuse.

The US$ 330-million Bundamba Advanced Water Treatment Plant, located 30 kilometers west of Brisbane in Queensland, is the central part of the state government's US$ 1.8-billion Western Corridor Recycled Water Scheme. This initiative is also part of a more comprehensive US$ 9-billion plan to secure southeast Queensland's water supplies for the next 50 years. In addition to advanced water treatment plants, the program will provide new dams and desalination plants. A "water grid" pipe network consisting of more than 500 km of pipes will link these new facilities with the existing water supply infrastructure.



An engineer checks out the microfiltration pumps and pipework in the Stage 1A Microfiltration-Reverse Osmosis (MFRO) building.



The raw water tanks are under construction in Stage 1A of the Bundamba advanced water treatment plant.

Reflecting the severity of the nation's worst drought in 100 years, the Bundamba project is the result of the unprecedented water supply pressures facing much of Australia. The state government has been searching for innovative ways to help meet growing water demands, but as the drought deepened, officials decided to bring the plant online more quickly within just 12 months of awarding a contract to the lead contractor Thiess of Queensland.

The project alliance team consists of Thiess, process designer Black & Veatch (USA), and the Queensland government's Coordinator General's Department, which owns the project. In order to provide the alliance with a convenient single point of contact for engineering services, Parsons Brinckerhoff teamed up with the Australasian engineering services company Beca to provide design services, including geotechnical investigation, interpretation and footing design; civil engineering design of earthworks, roadworks and drainage; structural engineering design of tanks, pump stations, process buildings, chemical, electrical and waste treatment areas; electrical engineering design of high voltage reticulation, earthing and lightning protection; acoustic modeling; traffic modeling; architectural design; and construction phase services, including engineering and environmental inspections and monitoring, and obtaining final building approvals.

Unique approach

PB had to design the infrastructure for the process without any previous plants to use as examples. Previous experience in the United States for similarly-sized but less complex facilities typically required a minimum of six months for design and nine months for construction, so 12 months to deliver a new type of plant was going to be a very tall order.

Previously, water-recycling projects produced non-potable water for use in industrial processes. The Bundamba facility pushes technology a step further. The process for the new plant uses a unique combination of technologies never before applied to a project of this scope. A pre-treatment stage blends and stabilizes effluent from four existing wastewater treatment plants, each with different proportions of domestic and industrial waste. The raw water then passes through successively finer filters, microfiltration (MF) and reverse osmosis (RO) before finally being sterilized using a combination of hydrogen peroxide and ultraviolet (UV) light. Siemens Memcor supplied the MF/UF pre-treatment systems, and Koch Membrane Systems supplied the RO systems. The operations team included Veolia Water and Separation Processes, Inc.

Major components of the project include:

- A 15-ML raw water storage tank and a 66-ML/d pre-treatment facility for buffering, mixing and treating raw sewage and wastewater from a variety of domestic and industrial sources;
- Five major pumping stations for both raw and treated water with a total pumping capacity in excess of 240 ML/d;
- Two process buildings totaling 4,000 m^2;
- Two chemical delivery and storage areas containing up to a four-week supply of treatment chemicals, including 98 percent sulfuric acid, methane gas and two x 1,500-t lime silos;
- Two 10-ML treated water tanks;
- A 3-ML overflow tank;
- Two waste treatment areas each of which is 5,000 m^2 for removing nitrogen, phosphates and other chemicals from the waste stream;
- A 1,000-m^2 dewatering building containing centrifuges that concentrate solids extracted from the water into a thick cake for disposal to landfill;
- High-voltage electrical switch rooms and 1.5 and 2.5 MVA transformer compounds including backup generators.

Project challenges

The 10-hectare project site, which was plagued by difficult ground conditions, was chosen because of its site next to an existing sewage treatment plant. Located on a floodplain, the ground was soft and variable in its consistency and initially a pile foundation was proposed for all of the large tanks, buildings, and pump stations.

Bundamba plant wins Global Project Award

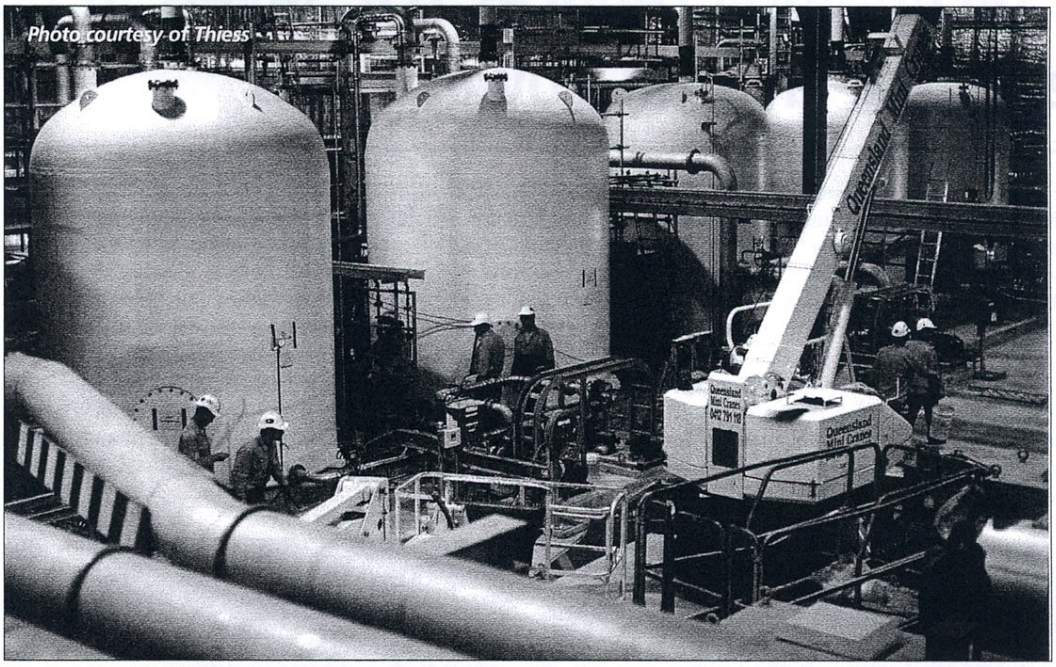
The monthly newsletter *Global Water Intelligence* presented its "Global Water Project of the Year Award" to Stage 1A of the Bundamba Advanced Water Plant in Australia, which produced purified recycled water only 10 months after construction began.

The Bundamba project achieved ambitious targets during the design, construction, and commissioning stages. On the former paddock where the Bundamba plant now sits, the groundbreaking operations started in November 2006. By August 2007, the plant produced purified recycled water; and Stage 1A was officially opened in September 2007, the same month in which the project exceeded the one-million-man-hour mark with zero lost-time injuries, a remarkable record for a work site with such intense activity.

"This is an excellent example of our integrated global workforce at work; it's the only way we could deliver a project of this magnitude on such a fast track," said Dan McCarthy, president and chief executive officer of Black & Veatch's global water business. "We mobilized professionals from many different office sites and had a strong international team on the ground that was supported by global design and resource centers in Singapore, Mumbai, Hong Kong, Beijing, the United States, and the United Kingdom," he added.

The purified recycled water from the Bundamba advanced water treatment facility is piped from the plant via a 7.3-km-long, 800-mm-diameter pipeline into the lake at the CS Energy Swanbank Power Station, reducing the power station's reliance on the drought-affected Wivenhoe Dam and ensuring that the power station remains available to support southeast Queensland's growing electricity needs.

At Stage 1A, the Bundamba plant produces up to 30 million liters daily. Following the entire completion of the project, scheduled for December 2008, the project will be supplying up to 232 ML/d of purified recycled water.



The Clean-in-place (CIP) tanks are located inside the Microfiltration-Reverse Osmosis (MFRO) Building in Stage 1A of the Bundamba advanced water treatment plant.

With insufficient pile rigs available to drive upwards of 2,000 piles that would have been required for the first stage of this two-stage project, a ground improvement scheme was recommended that would strip up to 1.5 m of soft and highly reactive clay material from the surface and replace it with a strong engineered fill. This engineered fill consisted of CBR35 material (California Bearing Ratio) and proved to be a quick and effective solution to the difficult ground conditions.

All of the large tanks are square or rectangular in shape and up to 10-m-high. Reinforced concrete was used for the construction of all of the major tanks and most of the smaller ones. Construction of a square tank is relatively straightforward due to its shape and simple flat formwork compared with a circular tank. However, the square tanks were more complex to design and detail because the corners produce high stresses that could lead to concrete cracking and leaks. In addition, the daily surface temperature varies from +45°C in the summer to -5°C in winter, producing thermal stresses that can exceed the stresses caused by the water stored inside the tanks. Finite element computer modeling was used to confirm the design details for the large tanks.

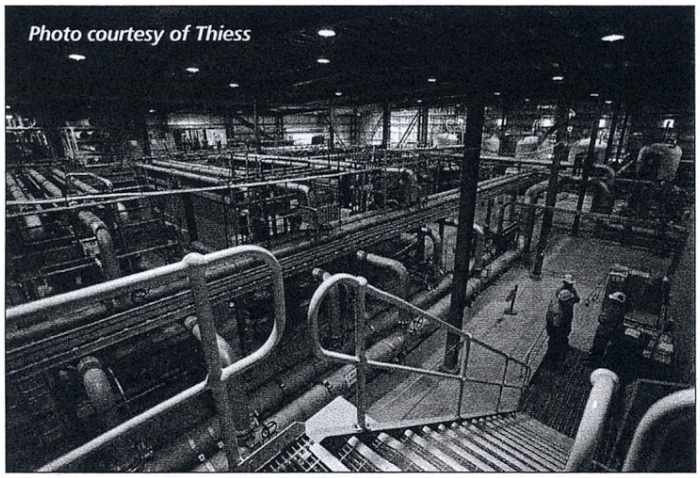
The steel-framed process buildings feature pre-painted steel sheeting with a post-and-beam configuration to provide maximum flexibility for erection. In some cases, the treatment plant equipment was installed first and the building was constructed around it.

To keep the public informed of the progress of the work, the Western Corridor Recycled Water project established web sites and community consultation groups for various water projects, including the Bundamba plant. In addition to the web site, local residents were kept up to date on the project's progress through newsletters and community functions such as weekend barbeques, breakfast information sessions, and project open days.

Prior to the start of earthworks on the site, local indigenous inhabitants were invited to inspect the site for traces of earlier habitation and any artifacts. Once construction started on the site, the contractor set out to build a relationship with the local community by sponsoring local sports teams and local fundraising efforts by nearby schools and community groups.

Stage 1A of the project was originally intended as a 20-ML/d pilot plant, but it was changed to a 30-ML/d full-scale production plant as the drought intensified. Construction was undertaken with two working shifts, 20 hours a day, six days a week over an eight-month period to meet the project schedule. In the end, Stage 1A, which was commissioned in August 2007 with an initial production rate of 15ML/d, was delivered three days ahead of schedule and on budget.

Stage 1B renders the Bundamba plant capable of producing up to 66 ML/d at full production, the third largest advanced water treatment initiative in the world. The recycled water being produced is not only clean enough to drink; it is of a higher quality than most potable water reserves.



The Bundama water recyling plant started operating within only 12 months of awarding a contract to Thiess of Queensland.